

**Evolutionary relationships among food habit, loss of flight, and reproductive traits
in the Silphinae (Coleoptera: Silphidae)**

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Flightlessness in insects is generally thought to have evolved due to changes in habitat environment or habitat isolation. Loss of flight may have changed reproductive traits in insects, but very few attempts have been made to assess evolutionary relationships between flight and reproductive traits in a group of related species. We elucidated the evolutionary history of flight loss and its relationship to evolution in food habit, relative reproductive investment, and egg size in the Silphinae (Coleoptera: Silphidae). Most flight-capable species in this group feed primarily on vertebrate carcasses (necrophagous), whereas flightless or flight-dimorphic species feed primarily on soil invertebrates (predaceous). Ancestral state reconstruction implied that flight muscle degeneration occurred twice in association with food habit changes from necrophagy to predatory (Fig. 1), suggesting that flight loss could evolve independently from changes in the environmental circumstances per se. We found that total egg production increased with flight loss. We also found that egg size increased with decreased egg number following food habit changes in the lineage leading to predaceous species, suggesting that selection for larger larvae intensified with the food habit change. This correlated evolution has shaped diverse life history patterns among extant species of Silphinae.

Keywords: life history evolution, egg production, egg size, flight muscle, necrophagous, predaceous

